Standard Operating Procedure

Undergraduate Program Assessment and Control (UPAC)

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1. **Purpose**

This Standard Operating Procedure (SOP) establishes the policies, procedures and instruments to be used for defining, assessing, and maintaining the baccalaureate degree programs in Electrical Engineering (EE) and Computer Engineering (CpE). Specifically, it:

1. Identifies the *constituencies* served by this department, and representative groups for each;
2. Defines the broad high-level *Program Objectives* for each program,
3. Defines more specific, measurable *Program Outcomes* for each program,
4. Identifies the relationships between the Program Objectives, Program Outcomes, curriculum, and ABET accreditation criteria [2],
5. Defines the structure and implementation of the program assessment processes including responsibilities, assessment instruments, reports, and schedules.

2. **Responsibilities**

1. **ECE Department Faculty**: has the final authority for oversight, maintenance, revision and approval of this SOP and all actions specified herein.

2. **Undergraduate Program Committee (UPC)**: has the authority and responsibility to execute this procedure on behalf of the ECE Department faculty. In addition, the UPC may, without prior faculty approval, implement minor editorial and/or cosmetic revisions that do not alter the intent of the document.

3. **ECE Assessment Coordinator (AC)**: serves as chair of the UPC, and executes other specific duties defined herein. Actions listed herein as the responsibility of the Assessment Coordinator (AC) may be delegated by the AC to another member of the UPC. However, ultimate responsibility remains with the AC.
3. Constituencies

The department’s undergraduate programs serve three main constituencies: students, employers, and graduate schools, each of which has its own representative body or bodies.

3.1. Students

Our primary constituents are the students themselves, including current students, prospective students, and their families. The primary representative body for students is the department’s Undergraduate Advisory Committee (UAC). In addition, the department maintains an open-door policy, by which any student may informally express his/her concerns or opinions to the Department Chair or Associate Chairs. Finally, there are several formal instruments for gathering student and alumni input, as detailed in Section 5.

3.2. Employers

As the primary employers of our graduates, commercial, industrial and governmental entities have a major stake in the quality and content of our program.

- For CpE program, employers include both primary computer manufacturers and other industries and agencies whose products, processes, or systems employ embedded and/or general-purpose computer systems.
- For the EE program, primary employers are engineering and business consulting firms, government agencies, and manufacturers of electrical and electronic and computer and office equipment, industrial machinery, and professional and scientific instrumentation. Other employers include transportation, communications, and utilities firms as well as computer and data processing services firms.

The ECE Department’s External Advisory Committee (EAC) is the primary representative body for this constituency. The EAC meets semi-annually, with several goals: to help assess the Department’s teaching, research, and service programs; to serve as a sounding board in the Department’s planning process; and to provide a front-line perspective on industrial applications of electrical and computer engineering.

3.3. Graduate Schools

The baccalaureate degree is the foundation upon which post-graduate education is built. The department is therefore mindful of its duty to provide graduates with the background, skills and perspective needed to pursue a career in research and education.

The primary representative body for graduate schools is the ECE Department Graduate Committee. Their role is to represent the needs and wants of graduate programs regarding the knowledge base and abilities of our graduates.
4. Undergraduate Program Specifications

This section formally defines the Program Objectives and Program Outcomes for the ECE department’s Baccalaureate degree programs. In addition, it specifies the mapping between the Objectives, Outcomes, and those activities and components tasked with achieving the Outcomes.

4.1. Definitions

The baccalaureate programs are defined in terms of Program Objectives, Program Outcomes, and the Academic Curriculum. This subsection defines these terms and their relationships to each other. Subsections 4.2 and 4.3 then specify these properties for the CpE and EE degrees, respectively.

- **Program Objectives** are broad, general statements of the ultimate high-level skills and knowledge base desired of our graduates, expressed in layman-friendly terms. As such, they are inherently difficult to assess directly. However, they are amenable to indirect measurement by mapping them into a set of more specific Program Outcomes.

- **Program Outcomes** are detailed, measurable statements derived from the Program Objectives, which provide the means of measuring the degree of the objectives’ achievement.

- **Academic Curriculum**, combined with extracurricular activities, constitutes the formal pedagogical means for accomplishing the Program Outcomes.

Thus, Program Outcomes are the pivotal link in the system, as they provide a visible and measurable linkage between the curriculum and the Program Objectives. Specifically:

- Each Program Objective is mapped into to one or more Program Outcomes.

- Each Program Outcome is mapped into one or more courses that contribute to the accomplishment of that outcome.

- The ABET mandated outcomes of Criteria 3, 4, and 8 are a subset of the Program Outcomes [2].
4.2. CpE Program Specification

4.2.1. CpE Program Objectives

A Computer Engineer is uniquely qualified to view a computer-based system as an integrated continuum of technologies, and to perform end-to-end design of the entire system, spanning both sides of the traditional hardware/software boundary. Therefore, each graduate of this program shall acquire:

1. The ability to integrate computer hardware and software in order to design, model, implement, program, test, and document complete computer-based solutions to engineering problems;

2. A broad foundation in computer science, computer programming, the physical sciences, engineering principles, digital electronics and mathematics, allowing him/her to collaborate effectively with other professionals over the entire spectrum of digital system design.

3. The technical breadth, hands-on application, communication skills, and teamwork skills needed to enter commercial engineering practice and quickly become a productive member of a professional engineering team.

4. The depth of knowledge and analytical skills necessary to pursue post-graduate education, and recognize the need for continuing educational and professional development whether or not advanced degrees are being sought.

5. A broad educational background in professional ethics, the humanities, and the social sciences needed to function as responsible and ethical members of the profession and society.

4.2.2. CpE Program Outcomes

Graduates of this program shall have demonstrated:

(a) ability to apply knowledge of mathematics, science, and engineering to the design, analysis and/or implementation of digital systems and components,

(b) ability to design and conduct experiments, as well as to analyze and interpret data, including statistical analysis methods for experimental estimation of system performance,

(c) ability to design an integrated hardware/software-based system, component, or process to meet desired needs,

(d) ability to function on multi-disciplinary teams,

(e) ability to identify, formulate, find, and choose among alternative computer-based solutions for engineering problems,

(f) understanding of professional and ethical responsibility, plagiarism, and intellectual property issues including the IEEE Code of Conduct and NSPE Code of Ethics,

(g) ability to communicate effectively in IEEE-compatible written and oral presentation styles,

(h) receipt of a broad education necessary to understand the impact of engineering solutions in a global and societal context,

(i) recognition of the need for, and an ability to engage in life-long learning,

(j) knowledge of contemporary issues,

(k) ability to use relevant techniques, skills, and modern computer-engineering tools, including methods and tools for modeling and simulation of digital system performance and dependability,
(l) ability to function in a major design experience incorporating most of: economic, environmental, sustainability, manufacturability, ethical, health and safety, social, and political considerations,

(m) completion of: 1 year of mathematics and basic sciences, including experimental experience;

(n) completion of 1.5 years of engineering topics;

(o) completion of a broad, non-technical general education component,

(p) knowledge of discrete math, probability & statistics, calculus, diff. equations, linear algebra, basic sciences, computer science, and engineering sciences necessary to analyze and design complex electrical and electronic devices, software, and systems containing both hardware and software,

(q) proficiency in computer programming, data structures, algorithms, and numerical methods, including familiarity with at least 2 high-level languages, 2 assembly languages, and 1 hardware description language.

(r) depth of knowledge indicated by completion of courses whose prerequisite precedence graph has a depth of at least 3 dependent courses, and by at least 6 credits in one technical elective focus track,

(s) breadth of knowledge spanning the areas of electronics, signal processing, logic design, computer architecture, operating systems, fundamentals of computer science, and technical electives spanning more than one focus track.

4.2.3. CpE Program Component Relationships

This subsection defines the relationships between Program Objectives, Program Outcomes, Curricular and extra-curricular activities, and relevant ABET criteria.

Program Outcomes are the pivotal elements in the assessment process. Each outcome is a measurable phenomenon that maps to one or more Program Objectives, and/or to ABET Criteria 3, 4, or 8 [2]. Similarly, the curriculum is mapped directly to outcomes. Thus, Program Outcomes are the link between the curriculum and the Program Objectives. Table 1 summarizes these relationships.
### Table 1: Relationships between CpE Outcomes, Objectives, ABET Criteria, and Curriculum

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Objective(s)</th>
<th>ABET Criteria</th>
<th>Courses and Activities Contributing to the Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>1,3</td>
<td>3(a)</td>
<td>EE: 2303, 2304, 2301, 3301, 3173, 3970, 4901, 4910</td>
</tr>
<tr>
<td>(b)</td>
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<td>3(b)</td>
<td>MA: 3170, EE: 3970, 3175, 4900</td>
</tr>
<tr>
<td>(c)</td>
<td>1</td>
<td>3(c)</td>
<td>EE 3173, 4901, 4910</td>
</tr>
<tr>
<td>(d)</td>
<td>2, 3</td>
<td>3(d), 4</td>
<td>EE: 4900, 4901, 4910</td>
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<tr>
<td>(e)</td>
<td>1</td>
<td>3(e)</td>
<td>EE 3970, 4901, 4910</td>
</tr>
<tr>
<td>(f)</td>
<td>5</td>
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<td>EE 3970, 4901, 4910</td>
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<td>(g)</td>
<td>3</td>
<td>3(g)</td>
<td>EE 3970, 4900, 4901, 4910</td>
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<td>(h)</td>
<td>5</td>
<td>3(h)</td>
<td>General Education Courses (28 credits)</td>
</tr>
<tr>
<td>(i)</td>
<td>4</td>
<td>3(i)</td>
<td>EE 3970, EE 4900, Prerequisite Review Exams, IEEE activities</td>
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<tr>
<td>(j)</td>
<td>5</td>
<td>3(j)</td>
<td>General Education Courses (28 credits)</td>
</tr>
<tr>
<td>(k)</td>
<td>1</td>
<td>3(k)</td>
<td>EE-3173, 3175</td>
</tr>
<tr>
<td>(l)</td>
<td>1,2</td>
<td>4</td>
<td>EE 4900, 4901, 4910</td>
</tr>
<tr>
<td>(m)</td>
<td>2</td>
<td>4(a)</td>
<td>MA 1160, 2160, 2370, 3520, 3710, CH: 1100, PH 1100, 1200, 2100, 2200, CS 2311, CS-2911</td>
</tr>
<tr>
<td>(n)</td>
<td>2</td>
<td>4(b)</td>
<td>EE 2110, 2150, 2171, 2303, 2304, 3130, 3160, 3173, 3175, 3301, 3303, 3173, 3900, Technical Electives (9 cr.).</td>
</tr>
<tr>
<td>(o)</td>
<td>5</td>
<td>4(c)</td>
<td>General Education Courses</td>
</tr>
<tr>
<td>(p)</td>
<td>3</td>
<td>8</td>
<td>MA 1160, 2160, 2320, 3520, 3710</td>
</tr>
<tr>
<td>(q)</td>
<td>1,2</td>
<td>8</td>
<td>CS 1121, 1122, 2311, 2321, 2141, 2911, 3421, EE 3173</td>
</tr>
<tr>
<td>(r)</td>
<td>1,4</td>
<td>8</td>
<td>CS 4411, EE 3173, 3175, 3900, Technical Electives Depth Requirement</td>
</tr>
<tr>
<td>(s)</td>
<td>2,3</td>
<td>8</td>
<td>CS: 2311, 2321, 2141, 3421, 4411, EE: 2110, 2150, 2171, 3130, 3173, 3175 Technical Electives Breadth Requirement</td>
</tr>
</tbody>
</table>
4.3. EE Program Specification

4.3.1. EE Program Objectives

Electrical Engineering is a very broad field, having within its scope many areas of specialization. Although each of these areas is in many ways unique, all require a common body of knowledge in fundamental electrical engineering. Developing this common body of knowledge requires a solid foundation in mathematics and the sciences. The dynamic nature of the field requires its practitioners to continue to develop technically throughout their working careers. Therefore, each graduate of this program shall possess:

1. The necessary fundamental knowledge and skills to qualify for entry into the profession of electrical engineering. Currently this requires a broad foundation in mathematics, the physical sciences and general as well as electrical engineering principles as well as an understanding of the ethical responsibilities of practicing the profession of electrical engineering.
2. Sufficient depth of knowledge in one or more areas of electrical engineering to either practice in the profession or to pursue advanced degrees.
3. The ability to apply his/her knowledge and skills in electrical engineering to the creative solution of problems both independently and as a member of an engineering team.
4. The ability to communicate these solutions effectively.
5. The realization that being an effective member of the engineering profession requires life-long learning.

4.3.2. EE Program Outcomes

As prescribed in ABET EC2000, graduates of this program shall have demonstrated they have the following general engineering traits:

a) the ability to apply knowledge of mathematics, science and engineering
b) the ability to design and conduct experiments, as well as to analyze and interpret data
c) the ability to design a system, component, or process to meet desired needs.
d) the ability to function on a multi-disciplinary team
e) the ability to identify, formulate and solve engineering problems
f) an understanding of professional and ethical responsibility
g) the ability to communicate effectively
h) the broad education necessary to understand the impact of engineering solutions in a global and societal context
i) recognition of the need for, and an ability to engage in life-long learning
j) knowledge of contemporary issues
k) the ability to use the techniques, skills, and modern engineering tools necessary for
Additionally, the electrical engineering graduates of this program shall also have demonstrated that they have the following:

l) knowledge of probability and statistics, including applications appropriate for electrical engineers.

m) knowledge of mathematics through differential and integral calculus, basic sciences, and engineering sciences necessary to analyze and design complex electrical and electronic devices and systems containing electrical and electronic components.

n) knowledge of advanced mathematics, typically including differential equations, linear algebra, complex variables, and discrete mathematics.

4.3.3. EE Program Component Relationships

This subsection defines the relationships between Program Objectives, Program Outcomes, Curricular and extra-curricular activities, and relevant ABET criteria.

*Program Outcomes are the pivotal elements* in the assessment process. Each outcome is a measurable phenomenon that maps to one or more Program Objectives, and/or to ABET Criteria 3, 4, or 8 [2]. Similarly, the curriculum is mapped directly to outcomes. Thus, Program Outcomes are the link between the curriculum and the Program Objectives. Table 2 summarizes these relationships.
### Table 2: Relationships between EE Outcomes, Objectives, ABET Criteria, and Curriculum

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Objective(s)</th>
<th>ABET Criteria</th>
<th>Courses and Activities Contributing to the Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>1</td>
<td>3(a)</td>
<td>EE 4901, 4910 (or Enterprise)</td>
</tr>
<tr>
<td>(b)</td>
<td>1</td>
<td>3(b)</td>
<td>EE 2303, 2304, 3301, 3302, 3304</td>
</tr>
<tr>
<td>(c)</td>
<td>1</td>
<td>3(c)</td>
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<td>(d)</td>
<td>2,3,4</td>
<td>3(d), 4</td>
<td>EE 4901, 4910, (or Enterprise)</td>
</tr>
<tr>
<td>(e)</td>
<td>1</td>
<td>3(e)</td>
<td>EE 4910, 4910, Senior. Electives</td>
</tr>
<tr>
<td>(f)</td>
<td>1,5</td>
<td>3(f)</td>
<td>EE 4900</td>
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<td>(g)</td>
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<td>3(g)</td>
<td>EE 2303, 2304, 3301, 3302, 3304, 4901, 4910</td>
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<tr>
<td>(h)</td>
<td>1</td>
<td>3(h)</td>
<td>General Education Courses (28 credits)</td>
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<tr>
<td>(i)</td>
<td>5</td>
<td>3(i)</td>
<td>EE 4900, Prerequisite Review Exams, Professional Societies,</td>
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<td>(j)</td>
<td>1</td>
<td>3(j)</td>
<td>General Education Courses (28 credits)</td>
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<tr>
<td>(k)</td>
<td>1</td>
<td>3(k)</td>
<td>EE 4901, EE 4901 (or Enterprise), EE Electives</td>
</tr>
<tr>
<td>(l)</td>
<td>1</td>
<td>8</td>
<td>MA 3720, EE Electives</td>
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<td>(m)</td>
<td>1,2</td>
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<td>MA 1160, 2160, 3520</td>
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<td>(n)</td>
<td>2</td>
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<td>MA 3160, 2320, EE2150</td>
</tr>
</tbody>
</table>
5. Assessment Process

Quality Control and Quality Assurance of the undergraduate programs can only be achieved through a formal process of assessment, evaluation and revision based on the committed and continuous involvement department administration, rank-and-file faculty and our constituencies. This section establishes the program assessment processes and procedures for this department.

5.1. Process Structure

The process consists of two separate and concurrent cycles (loops), as defined by the Accreditation Board for Engineering and Technology (ABET), in the Engineering Criteria 2000 (EC2000) accreditation documents [1, 2]. As implemented in this program, the two loops illustrated in Figure 1 have the following properties:

- **The left-hand loop** (or slow loop) represents a three-year cycle focusing on assessment and revision of the high-level Program Objectives. The goal of this loop is to determine whether the Program Objectives are relevant, appropriate, and serve the needs of our constituencies. This assessment loop does not attempt to determine how well the current Program Objectives are being satisfied.

- **The right-hand loop** (or fast loop) represents an annual cycle of activities focusing on assessment and revision of the Program Outcomes and Curriculum to improve the manner in which the program achieves the Program Objectives defined in the slow loop.

![The Two Loops of EC2000](image)

Figure 1: Two loop ABET assessment process [1]
5.2. Target Attributes

A necessary part of any assessment process is evaluation of the process itself. We therefore establish the following target attributes against which our assessment processes can be evaluated.

1. Completeness: Assessment processes shall assess all Outcomes or Objectives, as appropriate. However, not all Outcomes need be assessed to the same degree of detail within a given year.

2. Accountability: Assessment processes shall provide documented formal mechanisms for justifying, defining, and documenting actions taken to revise the undergraduate programs and assessment processes. Data that is not reliably observable by the UPC shall not be used for assessment.

3. Consistency: The AC shall maintain a single date-stamped Master Copy of each governing document and report in a single format (with the exception of blank templates). Republishing, reformatting, duplicate storage and redundancies between documents shall be avoided.

4. Sustainability: Assessment processes shall not impose unsustainable workloads on rank-and-file faculty, department staff, the UPC, the AC, the constituencies or their representative bodies. Rather than attempting to solve all problems in a single year, the process shall identify a manageable subset of the most severe or urgent problems for immediate corrective action.

5. Efficiency: Duplication of labor shall be avoided at all costs. Assessment processes and documents shall maximize the amount of processed, useful information delivered relative to the time and resources invested. Philosophical pontification, proselytization, and hyperboli are not useful information and shall be avoided in all documents.

5.3. Implementation and Schedule

A diverse set of direct and indirect assessment instruments are used to assess Program Objectives, Program Outcomes, and the assessment process itself. There are three classes of reports to be filed:

1. Periodic and interim reports to the UPC, summarizing the results of individual assessment instruments. These reports are defined individually in Section 6.

2. Annual Outcomes Assessment Report from the UPC to the ECE department faculty is due early in the fall semester of every year. This report, defined in Section 7, presents the assessment from the previous academic year and prescribes corrective actions for the current academic year.

3. Triennial Objectives Assessment Report from the UPC to the ECE department faculty is due during the spring semester of every third year. This report, defined in Section 8, presents the assessment from the previous cycle and prescribes corrective actions for the current cycle.

Table 3 lists all reports, the responsible parties, deadlines, and whether a report is relevant to Objectives level or Outcomes level assessment. The following notes clarify the details of Table 3.

1. All items are due at the end of the week specified in Table 3. As used in Table 3, week “00” means the week before instruction begins, while week “16” means final exams week.

2. Unless otherwise specified, all items generated during summer sessions shall be grouped together with equivalent items from the following fall semester, and observe the fall semester deadlines.

3. All items with deadlines listed as “3rd fall” or “3rd spring” are due every third year, synchronized with the Objectives level assessment cycle. This cycle shall be synchronized so as to occur in the academic year following each ABET program review (generally on a 6-year cycle).
### Table 3: Assessment Instruments and Reports - Responsibilities and Deadlines

<table>
<thead>
<tr>
<th>Assessment Instruments and Reports</th>
<th>Reference</th>
<th>Outcome From:</th>
<th>Objective To:</th>
<th>Term</th>
<th>Due wk</th>
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<tbody>
<tr>
<td>Prereq Review Exam Report Forms</td>
<td>6.1</td>
<td>X</td>
<td>Instruc Office</td>
<td>Each</td>
<td>04</td>
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<td>Prereq Review Exam Summary Rept</td>
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<td></td>
<td>AC UPC</td>
<td>Each</td>
<td>08</td>
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<td></td>
<td></td>
<td>X</td>
<td>Instruc AC</td>
<td>Each</td>
<td>16</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>AC</td>
<td>Each</td>
<td>16</td>
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<tr>
<td></td>
<td>6.2</td>
<td>X</td>
<td>Instruc AC</td>
<td>Each</td>
<td>00</td>
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<td>Senior Design Instructor’ Assessments</td>
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<td>Each</td>
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<td>Senior Design Sponsor’s Assessments</td>
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<td>Each</td>
<td>06</td>
</tr>
<tr>
<td>Senior Design Summ. Rept (prev acad year)</td>
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<td></td>
<td>UPC</td>
<td>Each</td>
<td>06</td>
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<td>Course Spec Validation Forms</td>
<td>6.3</td>
<td>X</td>
<td>Validator AC</td>
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<td>Course Validation Summary Report</td>
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<td>Course Outcomes Verification forms</td>
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<td>ECE Senior Exit Survey Forms</td>
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<td>CoE Alumni Survey Rept (prev acad year)</td>
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<td></td>
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<td>Fall</td>
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<td>Ann. Outcomes Assessment Rept ( Final )</td>
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6. Assessment Instruments

This section provides detailed descriptions of the individual assessment instruments and their accompanying reports used in the program assessment process. These instruments are to be executed on the schedule shown in Table 3, and used in preparation of the Annual Outcomes Assessment Report and/or Triennial Objectives Assessment Report, as appropriate.

The coverage of each Outcomes assessment instrument with respect to Program Outcomes is shown in Table 4. In addition, the UPC may design and employ ad-hoc assessment instruments to assess special situations, obtain more detailed data, or experimentally augment the suite of assessment instruments described herein.

Upon completion of each instrument, the AC shall evaluate the results. Evaluation is the process of assigning “value” to assessment data. Care shall be exercised so as not to assign arbitrary values or thresholds simply for the purpose of demonstrating quantification. Rather, the preferred method of evaluating assessment data is rank ordering in order to identify the most severe or urgent problem areas.

Some assessment instruments could be construed to reflect upon the performance of individual faculty members. However, in the interest of achieving objective, unbiased reporting, no assessment instrument or report specified herein shall be made a part of any individual’s tenure or promotion file, with the exception that an individual may voluntarily choose to include data of his/her own choosing in his/her own file at his/her own discretion.
<table>
<thead>
<tr>
<th>EE Outcome</th>
<th>CpE Outcome</th>
<th>Prereq Review Exams</th>
<th>Senior Design Summ.</th>
<th>Course Spec Validation</th>
<th>Course Outcomes Verif.</th>
<th>Sophomore Surveys</th>
<th>Senior Surveys</th>
<th>Alumni Surveys</th>
<th>Lab Assessment Summ.</th>
<th>FE Exam Summary</th>
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6.1. Prerequisite Review Exam (PRE) Summary Report

6.1.1. Purpose

Prerequisite Review Exams (PREs) are given at the beginning of selected EE courses. Each PRE covers prerequisite material for the course in which it is given. PREs are intended to do the following:

- Assess how well prerequisite courses are delivering prerequisite knowledge,
- Non-invasively assess the effectiveness of prerequisite courses taught by other departments,
- Identify systemic weaknesses and omissions across the entire curriculum,
- Demonstrate to students the need to independently review previous material and refresh their knowledge on a regular basis,
- Allow instructors to raise course standards by minimizing the amount of time spent on review.

6.1.2. Implementation

PREs shall be given as early as practicable in each term. Each PRE must be graded and the PRE grade must count as part of the course grade (so students take it seriously).

6.1.2.1. Applicable Courses

A PRE is required in each term for all EE courses listed by number in Table 1 or Table 2, except for courses meeting one or more of the following conditions:

1. a course with no formal prerequisite courses,
2. courses EE-4900, EE-4901, EE-4910,
3. a course which is the second (spring) semester of a two-semester sequence AND the first course in the sequence was taught in the immediately preceding fall AND in the current academic year, both courses are taught by the same instructor.

In addition, a PRE may be given in any other course at the discretion of the instructor.

6.1.2.2. PRE Format and Style

The form, format, and style of each PRE are left to the discretion of each instructor. For example, it may be an in-class or take-home exam, open book or closed book, a homework assignment, a quiz, a lab practical exam, or any other format that can be graded.
6.1.2.3. PRE Administration

The content of each PRE is left to the discretion of each instructor. However, PREs are not intended to cover material in extreme depth, to reconstruct the level of detail typical of final exams, or to frighten students away from a course. The breadth and depth of the material should be limited to that which students can reasonably be expected to review and refresh within the limited time allotted.

Instructors shall take steps to ensure that the PRE is appropriate to the course, and to minimize the potential that the students will be penalized for inadequate or incomplete coverage of material in a prerequisite course. In particular:

1. **Provide** a study guide describing the major topics to be covered (except for take-home exams),

2. **Adhere** to the “Prerequisites by Topic” section of the Course Specification.

3. **Consider** (if practical) grading options that allow the student to compensate for possible inadequate or incomplete coverage of material in a prerequisite course. For example, consider giving a Pass/Fail PRE and/or allowing at least one opportunity to retest, correct, or retry the PRE.

6.1.2.4. PRE Reporting

1. **Instructors** shall use the PRE Report Form shown in section 6.3.3 to report the results of each PRE. If students are allowed to attempt the PRE more than once, then report only the first attempt scores.

PRE Report Forms shall be submitted to ECE office staff by the date specified in Table 3. Submit only the report form; do not attach the actual exams.

Instructors are encouraged, but not required to partition the PRE into broad topics (as appropriate to the individual course), then itemize each topic and its evaluation on a separate line of the form. If so desired, the instructor may simply report the entire PRE on “Everything Else” line and leave the other lines blank.

The “Instructor’s Comments” field of the PRE Report Form can be more informative than mere numbers in a table. Instructors may use this section to identify specific strengths or weaknesses that they have uncovered and to make any recommendations that they want the UPC to address.

2. **Department office staff** shall collect the forms and forward them to the AC as soon as practicable after they are collected,

3. **The AC** shall summarize PRE statistical results and comments, and report them to the UPC in writing.
6.1.3. ECE Department - Prerequisite Review Exam (PRE) Report Form

Crs. Num: ________________ Term: ____________ Instructor: ____________________________

Numerical Scores: Using the (0-4) scale below, answer the following question for each topic you list: “On average, how satisfactory was the prereq. knowledge demonstrated by the students on your PRE?”

<table>
<thead>
<tr>
<th>SPECIFIC TOPICS TESTED.</th>
<th>Very Unsatisfactory.</th>
<th>Unsatisfactory.</th>
<th>Satisfactory.</th>
<th>Almost satisfactory.</th>
<th>Meets the course requirements</th>
<th>Better than satisfactory.</th>
<th>Above &amp; beyond requirements</th>
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<tr>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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<tr>
<td>Everything Else (topics not itemized below)</td>
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<td>3</td>
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<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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Instructor’s Comments: Your observations, comments and recommendations can be much more enlightening than mere numerical scores. Use back of page or additional pages if necessary.
6.2. Senior Design Summary Report

6.2.1. Purpose
The senior design course sequence (EE-4900, EE-4901, and 4910) offers the primary opportunity for students to demonstrate abilities to participate in a significant design experience, and to exercise many of the higher level capabilities required by the Program Outcomes. Because of this unique and pivotal position in the curriculum, the senior design sequence is deserving of special assessment.

6.2.2. Implementation
Each term, two separate instruments shall be executed to assess the effectiveness of the senior design course sequence. They shall be written by the UPC in collaboration with the senior design instructors.

1. **Senior Design Instructor’s Assessment:** Each ECE instructor supervising an *EE-4910* design team or an *ENG-4960* design team shall complete an instructor’s assessment form for each team supervised. The form shall be written by the UPC in collaboration with the instructors to assess:
   a. How well the design sequence courses fulfill their stated course objectives (as listed in the course specifications),
   b. How well the design sequence courses fulfill their roles relative to the Program Outcomes (as listed in Tables 1 and 2),
   c. Problem areas identified by the instructors,
   d. Instructors’ recommendations for improvement of the course.

2. **Senior Design Sponsor’s Assessment:** Each sponsor representative shall be asked to complete a sponsor’s assessment form. The survey shall be written to assess:
   a. The overall quality of the oral presentations and written reports,
   b. Overall quality of the final designs, including how well they meet the project objectives, and their level of success in producing the specified deliverables,
   c. Problem areas identified by the observers.

Annually, the AC shall collect the surveys, analyze the results, and submit a Senior Design Summary Report to the UPC.

6.2.3. Coverage
Students taking (1) the Enterprise program design sequence with a supervisor from outside the ECE department, or (2) another department’s design sequence, are not covered by this instrument. If a statistically significant number of students start taking these alternative paths, then analogous instruments will need to be developed.
6.3. Course Specification Validation Report

6.3.1. Purpose

Individual courses are the means by which Program Outcomes are achieved. However, left as an open loop system, course specifications can diverge from their intended outcomes. Therefore, each EE course listed by number in Table 1 or Table 2 shall periodically be subjected to a Course Specification Validation procedure to determine whether the Program Outcomes listed in the course specification agree with those listed for that course in Tables 1 and 2.

6.3.2. Implementation

The AC shall establish a schedule such that the specification for each listed course is validated at least once in every three academic years. The AC may also initiate ad hoc validations of individual course specifications at his/her discretion. Validation

At the beginning of each semester:

1. The AC shall:
   a) select courses for validation during the current semester,
   b) assign a member of the UPC to serve as validator for that course (note the validator shall not be a lead or actual instructor for the subject course during the current semester),
   c) notify the lead and actual instructors of the validation.
2. The validator shall:
   a) provide all relevant instructions, forms, and information to the lead and actual instructors
   b) in consultation with the lead and actual instructor(s), fill out the Course Specification Validation form shown on the next page.
   c) in consultation with the lead and actual instructor(s), initiate any needed changes to the course specification or to Tables 1 and 2.
   d) Return the completed form to the AC.
3. The AC shall collect all Course Specification Validation forms from the validators and write a summary report including:
   a) A list of all course specifications validated that semester
   b) The status of any outstanding corrective actions recommended by the validators
ECE Department - Course Specification Validation Form

Term: _________________________________   Course Number: _________________________________

Lead Instructor: _________________________   Validator: _________________________________

Actual Instructor(s): _____________________________

<table>
<thead>
<tr>
<th></th>
<th>To be filled out by UPC Validator in consultation with instructors</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>In the Course Specification, does the list of Program Outcomes under the heading <em>Relationship of Course to Program Objectives</em> agree with the outcomes listed for this course in Tables 1 and 2 of the <em>Undergraduate Program Assessment and Control SOP</em>?</td>
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<tr>
<td>2</td>
<td>If the answer to question 1 was “No”, recommend corrective actions (attach additional pages, if needed).</td>
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<tr>
<td>3</td>
<td>In the Course Specification, are all Outcomes listed under the heading <em>Relationship of Course to Program Objectives</em> adequately implemented by their assigned course topics?</td>
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<td>4</td>
<td>If the answer to question 3 was “No”, recommend corrective actions (attach additional pages, if needed).</td>
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</table>
6.4. Course Outcomes Verification

As written, course specifications may or may not be feasible, complete, or effective. Furthermore, over time, actual course content can diverge from the specification. Thus, in order to “close the loop” on outcomes assessment, it is important to evaluate how well courses actually achieve the outcomes assigned to them by their course specifications. Chronic inability to do so may indicate that the specification is in need of revision.

All Program Outcomes require that students “shall have demonstrated…”. Verification documents how the students were required to “demonstrate” the required knowledge, abilities, or skills. The person with the most intimate knowledge of actual course content is the actual course instructor. Therefore, the following procedures shall be followed:

1. Each actual instructor shall, At the end of each semester, for each course taught:
   a) Fill out and sign the Course Outcomes Verification Form shown on the following page.
   b) Submit the completed form to the department office staff in order to receive the grade form.

2. Department staff members:
   a) Shall not hand out grade form for a given course until they have received the completed and signed Course Outcomes Verification Form for that course.
   b) When all forms have been collected, forward them to the AC.

3. The AC shall:
   a) Examine the Course Outcome Verification forms to identify chronic problems with a given course, and determine whether UPC action is needed to correct problems identified by the instructors.
   b) Write a summary report listing items requiring UPC action.
## ECE Department - Course Outcomes Verification Form

Instructor: ____________________________   Term: ________   Course Number: ___________

<table>
<thead>
<tr>
<th>Topics covered and outcomes demonstrated (copy from course spec)</th>
<th>Highest level to which students demonstrated knowledge of each topic (circle only one level)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPE Outcomes Served by each listed topic as listed in Course Spec</td>
<td>No assignments</td>
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<tr>
<td>Topics Covered as listed in Course Spec. (by topic number)</td>
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<tr>
<td>CPE Outcomes Served by each listed topic as listed in Course Spec</td>
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<td>CPE Outcomes Served by each listed topic as listed in Course Spec</td>
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<tr>
<td>CPE Outcomes Served by each listed topic as listed in Course Spec</td>
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Use extra copies of this page as needed

(Continued)
ECE Department - Course Outcomes Verification Form - Continued

1. The amount of material required by the course specification is: Way too much for 1 term, A bit too much for 1 term, Just about right for 1 term, A bit too little for 1 term, Way too little for 1 term.

2. List your recommendations for changes to the Course Specification or requests for other UPC assistance (attach additional sheets if needed).

3. List your detailed recommendations to the next instructor for improving course delivery
   Assume the next instructor is not yourself (attach additional sheets if needed).

Instructor’s Signature: _________________________________________________________________
6.5. Progressive Survey Summary Report

6.5.1. Purpose

A sequence of surveys solicits feedback from the students and alumni regarding the quality of their education at specific points in their careers. These surveys complement the UAC Outcomes Assessment described in Subsection 6.7 in that they permit a comprehensive quantitative evaluation of students’ opinions.

6.5.2. Implementation

6.5.2.1. Survey Instruments

Three survey instruments shall be used. These surveys shall be.

1. **ECE Sophomore Surveys** (written by the UPC) shall be given during each term in a required course normally taken during a student’s fourth semester.
   
   These surveys shall focus on courses and activities normally undertaken during the first two years of the EE and CpE programs.

2. **ECE Senior Exit Surveys** (written by the UPC) shall be given near the end of each term to students enrolled in EE-4910 or an ENG-4960 team supervised by an ECE department instructor. In addition, reasonable efforts shall be taken to include EE and CpE majors taking the final term of another department’s senior design sequence.
   
   These surveys shall inquire into the overall undergraduate experience, as well as future plans and the status of implementing those plans.

3. **College of Engineering (CoE) Alumni Surveys** (written by CoE with UPC input) are conducted annually.
   
   These surveys assess how well recent graduates feel the program has served their needs, from their perspective in the “real world”.

Annually, the AC shall collect and analyze the survey data, and report the results in writing to the UPC. In addition, the UPC shall provide program-specific questions for the CoE Alumni Surveys when so requested by the CoE.

6.5.2.2. Coverage

As implemented, the Sophomore Surveys should cover every student. The Senior Surveys may miss a small number of students taking senior design courses under a different department. If this number becomes statistically significant, then additional effort shall be expended to ensure that they are covered. CoE Alumni Survey coverage is the responsibility of the CoE.
6.6. Laboratory Assessment Summary Report

6.6.1. Purpose
Laboratory experiences are key elements in providing the students with the hands-on application of knowledge that distinguishes engineering from other academic pursuits. It is thus necessary to assess how well the laboratory courses fulfill this role.

6.6.2. Implementation
Each term, the ECE Department Laboratory Coordinator shall submit to the UPC a summary report assessing the quality and effectiveness of those laboratory courses under his/her control. This report should include:

1. A summary analysis of, and the Lab Coordinator’s conclusions about, a survey given roughly in the middle of the term to students enrolled in the laboratories. The survey should cover:
   a. The functioning of the laboratories themselves, including quality of instruction, organization, equipment, and reference material,
   b. The integration of the labs into the curriculum including coordination with requisite lecture courses (in both content and timing).

2. A summary of the Laboratory Coordinator’s conclusions regarding the quality and effectiveness of the lab courses, based on the coordinator’s observations, expertise and situational awareness.

3. A summary of actions taken by the Laboratory Coordinator to improve the laboratory courses.

4. The lab coordinator’s recommendations for UPC or faculty action items to improve the laboratory courses.
6.7. Fundamentals of Engineering (FE) Exam Evaluation

6.7.1. Purpose:

To evaluate how ECE graduates perform on the nationally normed Fundamentals of Engineering (FE) exam, relative to the national average. Since CpE graduates do not normally take the FE exam, this instrument primarily assesses the EE program, although the two curricula have much in common.

Given a maximum possible test score of $N_{max}$ the mean score for department graduates ($N_{mtu}$) shall be compared to the national mean score ($N_{nat}$). A department grade $G$ shall be calculated by the formula:

$$G = 2.0 \left[ \frac{N_{mtu} - N_{nat}}{N_{max} - N_{nat}} \right] + 2.0$$

This formula yields a 4.0 (A) for a perfect score, a 2.0 (C) in the MTU average equals the national average, and less than 2.0 if the MTU average is below the national average.

Using the most recently received test data, the AC shall calculate a value of $G$ for the overall test score, the ethics score, and the mathematics score. These results shall be reported in each Annual Outcomes Assessment report, along with recommendations for corrective actions appropriate to each value of $G$. Any grade in the vicinity of 2.0 or lower is a cause for specific concern.

For diagnostic purposes, similar metrics for other sections of the exam may also be reported, if they are considered useful.
6.8. UAC Outcomes Assessment

6.8.1. Purpose

The Undergraduate Advisory Committee (UAC) is the primary representative body for student input into the assessment process. Therefore, the UAC shall meet annually with the purpose of assessing the validity and relevance of the program outcomes and how well the program meets its outcomes, from the viewpoint of the current students.

6.8.2. Implementation

Annually, during the spring semester, the following shall occur:

1. The AC shall meet with the committee, to discuss issues related to program outcomes, and brief the committee on the status of all action items in the current Annual Outcomes Assessment Report.

2. The UAC shall meet separately to discuss Program Outcomes issues. The AC shall endeavor to provide the committee with whatever data the committee considers useful in this process.

3. The UAC shall submit a written report to the UPC expressing the UAC viewpoint regarding:
   
   - The validity and relevance of the Program Outcomes,
   - How well the curriculum achieves the Program Outcomes,
   - The most prominent strengths and weaknesses identified in the curriculum or the assessment process (of particular interest are any items that are not being adequately assessed),
   - Any recommendations for improving the Program Outcomes and assessment processes.

6.8.3. Comments and Advice

There is a temptation in assessment to try to solve all problems in the first year. This approach seldom works, as the workload turns out to be excessive. It is generally better to identify the few most glaring problems and focus on correcting them. Then, the program undergoes a continuous improvement process over years.

The usefulness of the written report will be enhanced if it is short and to the point. Rather than presenting a long “laundry list” of gripes and/or kudos, it is more useful if the UAC prioritizes its comments and provides a “short list” of items (for example, the top 3-5 and bottom 3-5 features or attributes of the program). While recommendations for corrective action can be useful, it is more important to identify and prioritize the most significant problems.

Student surveys should be used sparingly, or not at all. Assessment procedures already call for surveys of sophomores, seniors, and alumni. It is desirable that the UAC report be independent of these surveys.
6.9. UAC Objectives Assessment

6.9.1. Purpose

The Undergraduate Advisory Committee (UAC) is the primary representative body for student input into the assessment process. Therefore, the UAC shall meet every three years with the purpose of assessing the validity and relevance of the Program Objectives from the viewpoint of the students.

6.9.2. Implementation

Every third year, during the fall semester, the following shall occur:

1. The AC shall meet with the committee to discuss issues related to program objectives, and brief the committee on the status of all action items in the current Triennial Objectives Assessment Report.
2. The UAC shall meet separately to discuss Program Objectives issues. The AC shall endeavor to provide the committee with whatever data the committee considers useful in this process.
3. The UAC shall submit a written report to the UPC expressing the committee’s viewpoint regarding:
   - The validity and relevance of the Program Objectives,
   - Any problem areas identified,
   - Any recommendations for improving the Program Objectives.
6.10. EAC Objectives Assessment

6.10.1. Purpose

The External Advisory Committee (EAC) is the primary representative body for employer input into the assessment process. Therefore, the EAC shall meet at least once every 3 years with the purpose of assessing the validity and relevance of the Program Objectives from the viewpoint of the committee.

6.10.2. Implementation

Every third year, during the fall semester, the following shall occur:

1. The AC shall meet with the committee to discuss issues related to program objectives, and brief the committee on the status of all action items in the current *Triennial Objectives Assessment Report*.

2. The EAC shall meet separately to discuss Program Objectives issues. The AC shall endeavor to provide the committee with whatever data the committee considers useful in this process.

3. The ECE Department chair shall submit a written report from the EAC to the UPC expressing the committee’s viewpoint regarding:

   - The validity and relevance of the Program Objectives,
   - Any problem areas identified,
   - Any recommendations for improving the Program Objectives.
6.11. Graduate Committee Objectives Assessment

6.11.1. Purpose

The ECE Department Graduate Committee is the primary representative body for graduate program and graduate student input into the assessment process. Therefore, the Graduate Committee shall meet once every three years for the purpose of assessing the validity and relevance of the undergraduate Program Objectives from the viewpoint of representative graduate programs.

6.11.2. Implementation

Every third year, during the fall semester, the following shall occur:

1. The AC shall meet with the committee to discuss issues related to program objectives, and brief the committee on the status of all action items in the current Triennial Objectives Assessment Report.

2. The Graduate Committee shall meet separately to discuss Program Objectives issues. The AC shall endeavor to provide whatever data the committee considers useful in this process.

3. The committee shall consider student preparation for graduate study relative to:
   • our own graduate program and
   • a representative subset of other CpE and EE graduate programs (selected by the committee).

4. The committee shall submit a written report to the UPC expressing the committee’s viewpoint regarding:
   • The validity and relevance of the Program Objectives relative to graduate education,
   • Their assessment of the quality of preparation of our graduates for graduate study,
   • Any problem areas identified,
   • Any recommendations for improving the Program Objectives.
7. Annual Outcomes Assessment Report

Program Outcomes shall be subjected to an annual formal review process. The lead entity in the review process shall be the UPC. The Assessment shall be executed in the summer and fall of each academic year in accordance with the schedule in Table 3. The process yields three successive versions of the report: the Alpha Draft, Beta Draft, and Final Release versions, respectively.

1. **Alpha Draft**: The AC shall, during the summer, write the Alpha Draft version of the report and make it available to the UPC. The AC shall consider summary data and reports from the formal assessment instruments marked in the “Outcomes” column of Table 3 as well as any other ad-hoc or opportunistic data available. The structure of the report shall include:
   a. The itemized status of all “Required Action Items” prescribed in the previous year’s final report,
   b. A summary evaluation of the Program Outcomes, including:
      i) the relevance of the Program Outcomes for achieving the Program Objectives,
      ii) the effectiveness of the curriculum in achieving the Program Outcomes,
      iii) A discussion of items identified in the assessment data which may require action,
   c. An evaluation of the Outcomes level assessment process as specified and as practiced during the previous academic year, relative to:
      i) The Target Attributes defined in Subsection 5.2,
      ii) ABET’s Matrix for Implementation of Assessment [3, Fig. A-1].
      iii) Regional criteria similar to item 1.c.ii), if so requested by University authorities.
   d. A list of “Recommended Action Items” for the upcoming academic year,

2. **Beta Draft**: The AC shall submit the Alpha Draft version of the report to the UPC, who shall evaluate it, revise it as necessary, write the Beta Draft version, and submit it to the ECE Faulty. The structure of the Beta Draft is identical to that of the Alpha Draft defined in item 1 above.

3. **Final**: The department faculty shall meet for the purpose of reviewing the Beta Draft of the report, deciding on action items to be accomplished, and publishing a Final Release of the report. The Final Release shall be formatted identically to the Alpha and Beta Drafts defined above, with the exception that the “Recommended Action Items” specified in item 1.d above, shall be replaced by “Required Action Items” approved by the ECE Department faculty.

The AC and the UPC are responsible for overseeing the implementation of the Required Action Items identified in the Final Release.

The AC shall retain on file the 7 most recent Outcomes Assessment Reports (Final Releases only).
8. Triennial Objectives Assessment

Program Objectives will be subjected to a formal review process at least once every three years during the spring semester. The review cycle shall be synchronized so that each 2nd review occurs in the academic year immediately following regularly scheduled ABET review visits. The lead entity in the review process shall be the UPC.

The process shall proceed in accordance with the schedule in Table 3. The process yields three successive versions of the report: the Alpha Draft, Beta Draft, and Final Release versions, respectively.

1. **Alpha Draft**: The AC shall write the Alpha Draft version of the report and make it available to the UPC. The AC shall consider summary data and reports from the formal assessment instruments marked in the “Objectives” column of Table 3 as well as any other ad-hoc or opportunistic data available. The structure of the report shall include:
   a. The itemized status of all “Required Action Items” identified in the previous final report,
   b. A summary evaluation of the Program Objectives, including:
      i) the relevance of the Program Objectives with respect to the needs of the program constituencies,
      ii) the effectiveness and workability of Objectives assessment process as practiced during the previous cycle.
      iii) A discussion of items identified in the assessment data which may require action,
   c. A list of “Recommended Action Items” for the upcoming academic year,

2. **Beta Draft**: The AC shall submit the Alpha Draft version of the report to the UPC, who shall evaluate it, modify it as necessary, write the Beta Draft version, and submit it to the ECE Faculty for their consideration. The structure of the Beta Draft is identical to that of the Alpha Draft defined in item 1 above.

3. **Final**: The department faculty shall meet for the purpose of reviewing the Beta Draft of the report, deciding on final action items to be accomplished, and publishing a Final Release of the report. The final version shall be formatted identically to the Alpha and Beta Drafts defined above, with the exception that the “Recommended Action Items” in item 1.c shall be replaced by “Required Action Items” approved by the ECE Department faculty.

The AC and the UPC are responsible for overseeing the implementation of the “Required Action Items” identified in the Final Objectives Assessment Report.

The AC shall retain on file the 3 most recent Objectives Assessment Reports (Final Releases only).
9. References

